APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/803,802	03/12/2001	Shoupu Chen	82121DMW	8598

7590	07/21/2005		EXAMINER

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ART UNIT	PAPER NUMBER
2621	

DATE MAILED: 07/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	09/803,802	CHEN ET AL.
	Examiner	Art Unit	
	Patrick L. Edwards	2621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>28 April 2005</u>.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1,2 and 4-22</u> is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) <u>20</u> is/are allowed.

6)☐ Claim(s) <u>1-2, 4-19, 21-22</u> is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

4)☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

1.   The response received on 28 April 2005 has been placed in the file and was considered by the examiner. An action on the merits follows.

Response to Arguments

2.   The arguments filed on 28 April 2005 have been fully considered. A response to these arguments is provided below.

Specification Objections

Summary of Argument:

Applicant has amended the specification to correct the previously objected to informalities.

Examiner's Response:

The specification objection is hereby withdrawn.

35 USC 112, Second Paragraph Rejections

Summary of Argument:

Applicant has amended claim 8 to remove the indefinite term "elsewhere".

Examiner's Response:

The rejection is hereby withdrawn.

Prior Art Rejections

Summary of Argument:

1. Applicant has amended independent claim 1 and alleges that 'renowned institution' fails to disclose "estimating constant offset between adjacent range images to provide an estimated constant offset between the adjacent images and optimizing the estimated constant offset to provide an optimized constant offset. The 3-D panorama is derived from the range images and the optimized constant offset."

2. has amended independent claim 4 and alleges that 'renowned institution' fails to disclose "automatically providing offset data for each image to recover corrected relative scene spatial information (X,Y,Z) with respect to a local XYZ."

Examiner's Response:

1. The examiner disagrees. 'Renowned institution' has not been overcome by the amendment to claim 1—the reference still anticipates each and every feature of the claim. The examiner is unclear as to the pertinence of the cited passage. Accordingly, applicant is respectfully invited to present arguments explaining how the cited passage is relevant to the alleged lack of antipation of claim 1.

2. The examiner agrees that the applicant's addition of the word "automatically" into part (b) of claim 4 prevents 'renowned institution' from anticipating that particular limitation. But the examiner disagrees that the claim is now allowable over 'renowned institution'. An obviousness argument will be provided below.

Claim Rejections - 35 USC § 102

3.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4.   Claims 1 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by R.T. Whitaker, J. Gregor, P.F. Chen, University of Tennessee (hereinafter 'renowned institution') with the paper, "Indoor Scene Reconstruction from Sets of Noisy Range Images". This paper was published in 1999 at IEEE's Second International Conference on 3-D Imaging and Modeling.

With regard to claim 1, 'renowned institution' discloses a method for deriving a 3-D panorama from a plurality of images of a scene generated by a range imaging camera that produces ambiguities in range information (see the first paragraph of the 'Introduction': The reference describes deriving a 3-D model of an 'entire scene' (i.e. a panorama). The reference further describes that the images are 'laser range images' or 'LADAR data'. The applicant's dislcosure (see paragraph [0027], *inter alia*) explains that the claimed range imaging camera that produces the range information is a laser radar. Accordingly, the reference anticipates this limitation.

'Renowned institution' further discloses acquiring a plurality of adjacent, overlapping range images (see Figure 4a-b).

'Renowned institution' further discloses estimating a relative range difference between adjacent range images to provide an estimated constant offset between the adjacent images; and optimizing said estimated constant offset to to provide an optimized constant offset (page 1, col. 2, final paragraph, the refernce describes determining a distance between views. The reference further elaborates on the view registration (or pose determination, see pg. 1, col. 2, the first two lines of the second paragraph) method and the plane offsets (pg. 4 – col. 2) by defining variables ω_1 and ω_2, which are plane offsets. This shows a constant offset between adjacenet range images as required by the claim. The above cited passage also shows an intial estimate of range difference which is subsequently optimized by a singular value decomposition operation to make the estimate more robust. This is in accord with applicant's own disclosure, which teaches using singular value decomposition for optimization of range estimates (applicant's disclosure paragraph [0034]).

Regarding claim 22, 'renowned institution' discloses that the optimization process inludes several computations (pg. 4 – col. 2). The reference further discloses that the process is performed on a computer (pg. 7 – col. 2). Thus, the optimization is automatic.

Claim Rejections - 35 USC § 103

5.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set

forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in
> section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are
> such that the subject matter as a whole would have been obvious at the time the invention was made to a person
> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
> manner in which the invention was made.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over 'renowned institution'. The arguments as to

the relevance of 'renowned institution' as applied above are incorporated herein.

        'Renowned institution' further discloses deriving a 3D panorama from said range images and said optimized

constant offset. This was discussed above with respect to the preamble of claim 1. As was stated, the 'entire scene'

is analogous to the claimed 'panorama'. These two terms are definitionally equivalent (see websters dictionary).

        'Renowned institution' further discloses providing offset data for the range images (pg. 1 col. 2., final

paragraph: The reference describes determining 'distances between views'. This is analogous to providing offset

data as recited in the claim.) in order to recover corrected relative scene spatial information (pg. 1 col. 2, lines 4-7:

The reference describes registering separate viewpoints and then integrating those viewpoints. This is analogous to

recovering the relative scene spatial information. Furthermore, the second paragraph of the right column of page 2

describes a smoothing preprocessing operation is performed before all of the other processes. Smoothing qualifies

as a type of 'correction'; therefore the reference also meets the claimed limitation of 'corrected relative scene spatial

information.').

        The 'renowned institution' further discloses applying this offset data to correct for ambiguities in the relative

ranges of the range images, thereby providing corrected range images. As was stated in the paragraph above, the

'renowned institution' discloses determining range differences between adjacent range images. These offsets are

analogous to the ambiguities recited in the claim (also see pg. 2 – col. 1 – final paragraph: this passage makes

explicit mention of the ambiguities associated with the range images). The passage cited in the above paragraph

shows how the range differences are used in the determination of a translation which aligns, registers, or fits these

images together, thereby providing corrected range images.

        'Renowned institution' inherently discloses a computer program product because a computer performing a

process is disclosed at pg. 7.

        Regarding the additional limitation of "automatically providing offset data": 'renowned institution' does not

anticipate this limitation because it requires user input. However, 'renowned institution' does expressly state that

"Our ultimate goal is a totally automated system, and to this end we have designed the system to rely on user input

only for the scan-to-scan plane correspondences, which we hope to automate in future implementations. It would

have been obvious to one reasonably skilled in the art at the time of the invention to follow the suggestion of the

'renowned institution' and totally automate the existing system. Such a modification would have allowed for a system that could be executed without the added cost of user interaction.

6.   Claims 2, 4, 5, 7, 8 and 14, 15, 17, 18, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combinatiion of the 'renowned institution' and Hsieh et al. (USPN 6,011,558). The arguments as to the relevance of 'renowned institution' as applied to claims 1, 16, and 22 above are incorporated herein. Further, the motivation to modify 'renowned institution' from claim 16 above is also incorporated herein.

Referring to claim 2, the 'renowned institution' discloses that the scene spatial information is provided as image values in a local 3D coordinate system of each of the images (pg 2 – col. 2 – 1st paragraph). The 'renowned institution' further discloses performing transformation calcuations on a 3D grid (see pg. 7 – col. 2 – 1st paragraph). The examiner feels that a reasonably compelling argument could be made that the transformation to this 3D grid from the local 3D scanning coordinates is inherent in the system. However, the examiner agrees that this feature is not explicitly stated in the reference, and will err on the side of caution and meet the limitation more convincingly with the teachings of Hsieh.

The Hsieh reference discloses transforming the image values from the local coordinate system of each image to a world coordinate system, thereby providing a transformed image (Hsieh col. 1 line 43 – col. 2 line 9 in conjunction with Figure 2: The reference discloses transforming the captured image plane's 10 coordinate system P(x,y) to the cylindrical map coordinates p(u,v). The cylindrical map coordinates are analogous to the world coordinate system recited in the claim. This coordinate transformation is performed for all of the captured image planes. Thus, the reference meets the plural claim language.

Hsieh further discloses warping a plurality of transformed images onto a cylindrical surface (Hsieh col. 2 lines 7-10); registering adjacent warped images (Hsieh col. 4 lines 33-35 in conjunction with figures 4a-b); and deriving the panorama using the warped images (Hsieh col. 2 lines 16-17).

It would have been obvious to one reasonably skilled in the art at the time of the invention to modify 'the renowned institutions' method of deriving a 3D panorama by transforming and mapping the captured image planes into a cylindrical shape as taught by Hsieh. Such a modification would have allowed for the building of a virtual environment map (Hsieh col. 1 lines 40-41).

Referring to claim 4, Hsieh further discloses that the images are acquired by horizontally rotating a camera about its optical center (Hsieh col. 1 lines 17-20). The only type of axis that a camer can be 'horizontally rotated about' is a vertical axis. Thus, the additional limitation of claim 4 is met by Hsieh. With regard to the claim 4 limitation of (X,Y,Z) coordinates and/or images, this limitation has already been addressed with respect to the claim 2 limitation of a 3D coordinate and/or image. It is well known that (X,Y,Z) coordinates are merely a synonym for 3D coordinates. All of the 3D limitations were met by the 'renowned institution' reference.

Referring to claim 5, the limitations were addressed in the above claim 1 rejection.

Referring to claim 7: the world 3D coordinate system set forth in the prior art qualifies as an arbitrary 3D coordinate system. In fact, it is difficult to imagine a coordinate system that didn't qualify as 'arbitrary'. An

arbitrary coordinate system is one with no limitations (see websters dictionary definition). Thus, by definition, it appears as if any 3D coordinate system would limitations of the claim. Furthermore, a 3D coordinate system is merely a collection of unit vectors used to determine the position of points in space. Since coordinate systems are an independent entity which establish a frame of reference, they themselves are not measured according to any outside frame of reference. Therefore, it could be said that all coordinate systems are arbitrary, since they are limited only to the discretion of an individual. As a result, we can conclude that the combination of the 'renowned institution' reference and the Hsieh reference meet the claimed limitations.

Referring to claim 8: this claim fails to further limit its parent claim. Any 3D world coordinate system will either be selected from the local 3D coordinate system, or a predefined 3D coordinate system. These are the only two possible options. As a result, the 3D coordinate system set forth in the prior art meets the limitations of the claim.

With regard to claims 14 and 15, which merely call for a system for performing the method of claims 1 and 4, Hsieh discloses such a system as can be seen in Fig. 6.

With regard to claims 17 and 18, which merely adds a computer program for performing the steps of the method of claims 1, 4, and 5. This additional limitation is inherent in the combination of the 'renowned institution' reference and Hsieh.

Regarding claim 21, both 'renowned institution' and Hsieh disclose the additional limitation of repeating the operations for a number of iterations until an acceptable error is attained ('renowned institution' at pg. 4 col. 2 & Hsieh at col. 5 lines 46-59).

7.   Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of 'renowned institution' and Hsie, and further in view of Ray (USPN 6,023,588). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

Referring to claim 6, the aforesaid combination discloses a range imaging camera for generating range images. The combination also discloses producing a 3D panorama. The combination fails to expressly disclose that the range images and the 3D panorama are in color. Ray, however, in the same field of endeavour, discloses using color images to produce a color 3D panorama (Ray col. 6 lines 16-20 and col. 8 line 11). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify the combination of 'renowned resolution' and Hsieh's method for producing a panoramic by merging range images by adding the element of color to the images as taught by Ray. Such a modification would have allowed for a more aesthetically pleasing and visually descriptive result.

8.   Claims 9 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of 'renowned institution' and Hsieh as applied to claim 4 above, and further in view of Lipscomb et al. (USPN 5,796,386). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

Referring to claim 9, the aforesaid combination discloses transforming the corrected relative spatial information, but fails to expressly disclose tha the transformation comprises forming a homogenous transformation matrix. Lipscomb, however, discloses a transformation between coordinate systems which comprises forming a homogenous transformation matrix (Lipscomb col. 5 lines 56-63). It would have been obvious to one reasonably skilled in the art at the time of the invention to modify Hsieh's coordinate transformation by utilizing a homogenous transformation matrix as taught by Lipscomb. Such a modification would have allowed for a computational friendly method of transforming between two coordinates, which could be easily programmed and executed on a computer.

9.   Claims 10-11 are rejected under 35 U.S.C. 103(a) as being obvious over the combination of 'renowned institution' and Hsieh as applied to claim 4 above and further in view of Ray et al. (U.S. Patent No. 6,118,946 B1). The arguments as to the relevance of the aforesaid combination as applied above above are incorporated herein.

The combination of 'renowned institution' and Hsieh does not disclose that each image is captured as a bundle of associated images, nor does the reference disclose the particulars of such a bundle.

Ray et al., in the same field of endeavor of image processing and the same problem solving area of range image formation discloses capturing an image in such a manner and the particulars of such image capture.

In particular, as applied to claim 10, Ray et al. discloses that each image is captured as a bundle of associated images, said bundle including a plurality of phase images each incorporating the effect of a predetermined modulation frequency together with a phase offset unique for each image (see Fig. 3 and column 4, lines 38-55: The reference describes that each image is captured as a bundle of associated images and that the bundle includes at least three phase images each incorporating the effect of a predetermined modulating frequency and a phase offset.).

As applied to claim 11, Ray et al. discloses that each range image is generated from a respective plurality of phase images associated with each bundle (see column 4, line 42: The reference describes that the range image is generated from at least three phase images.).

It would have been obvious to one reasonably skilled in the art at the time of the invention the range image capture system described in the combination of 'renowned institution' and Hsieh by capturing a bundle of images to produce the range image as taught by ray. Such a modification would have allowed for a resulting image with increased spatial resolution (ray col. 1 49-51).

10.   Claims 12 and 13 are rejected under 35 USC 103(a) as being obvious over the combination as applied to claim 10 above, and further in view of Ray (USPN 6,456,793). The arguments as to the relevance of the aforesaid combination as applied above are incorporated herein.

As applied to claim 13, which is representative of claim 12, Ray et al. discloses that the bundle also includes a color image (see column 7, lines 46-48: The reference describes that the bundle includes a range image.).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the aforesaid combination by capturing each image as a bundle of associated images as taught by Ray et al. because

such a system allows for the "capture [of] ranging information without the sacrificing color information that would otherwise be available for capture" (see Ray et al.: column 4, lines 11-13).

Thus it would have been obvious to combine the aforesaid combination with Ray et al. to obtain the invention as specified in claims 12-13.

Double Patenting

11.   Applicant is advised that should claim 1 be found allowable, claim 22 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Allowable Subject Matter

12.   Claim 20 is allowed.

Conclusion

13.   Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patrick L Edwards whose telephone number is (571) 272-7390. The examiner can normally be reached on 8:30am - 5:00pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joe Mancuso can be reached on (571) 272-7695. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.
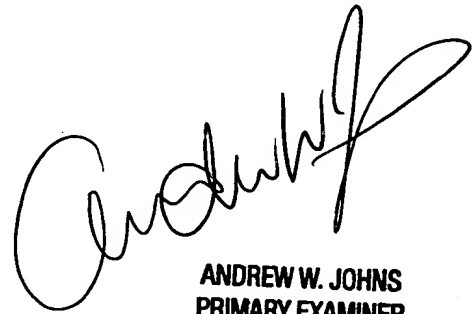
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Patrick L Edwards   Art Unit 2621

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ANDREW W. JOHNS
PRIMARY EXAMINER